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CURRENT COMMENTS

Proposal For a New Profession: Scientific Reviewer

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Just a few weeks ago, Harvey Brooks, the chairman of a congressional science panel, wrote a letter to *Science*[1] in which he solicited suggestions to improve the "health of the scientific and technological enterprise" in the United States. He specifically asked, among other things, "What alternatives might and should exist to the present traditional basic research and teaching careers for scientists and engineers who are trained to the Ph.D. level primarily through research and apprenticeship?"

I would like to offer a constructive response to Dr. Brooks' invitation. The suggestion which follows will be submitted to the Office of Technology Assessment's Panel on the Health of the Scientific and Technological Enterprise.

In fact, my suggestion addresses two separate but related problems: the unemployment of Ph.D.'s and the shortage of qualified literature reviewers. Both conditions are now deteriorating, and will probably continue to worsen until some positive action is taken.

First, consider the unemployment and underemployment of people with doctoral degrees. While the situation varies from year to year and from country to country, there can be little doubt that there now exists an abundance of people with Ph.D.'s; people who were trained to perform scientific research but who, because of the current economic condition of higher education, are unable to obtain faculty positions at universities. Some of these people can be employed by industry and government, but overall their opportunities are increasingly limited.

Second, consider the dilemma of publishers of scientific journals who find it extremely difficult to hire or locate people qualified to write scientific reviews. The need for reviews is already well documented. In any given specialty, after the publication of 50 to 250 articles there is usually a need to consolidate the information into a readable, authoritative "review." Such reviews are sorely needed by administrators and science policy makers as well as by the re-

searchers themselves.

There is ample evidence for the importance of reviews to the rapid advances in many fields. For instance, review journals achieve extremely high impact as measured in ISI® 's *Journal Citation Reports®* .[2] Also, co-citation studies have shown that a review paper can be comparable in importance to the milestone papers in the same field.[3]

In 1976 some 28,182 "review" articles were indexed for ISI's *Index to Scientific Reviews™* .[4] Of this total, less than half were originally written as reviews--that is, for the specific purpose of consolidating the literature. In addition to these, there are perhaps 10,000 chapters in multi-authored books which are classifiable as reviews.

Those concerned with scientific recognition and professional status might be attracted by the idea of reviewing the original research of others. In fact, the "social" prospects for reviewers are very good. Scientific reviewers are well known and highly respected. Many laboratory workers in rapidly growing fields wish that they themselves could handle the task of keeping tabs on the literature. When they try, they often find that they simply can't do it.

That this kind of intellectual activity is deeply appreciated by the research community is reflected in our citation studies. Last January, in an article published in *Nature*,[5] I demonstrated the extraordinary impact and increasing importance of review journals. I found that 80 review journals had achieved an impact of two or more. This indicates that the average journal article was cited at least twice in the two previous years. Only 300 primary journals in the world--out of thousands published--achieved an equivalent or higher impact.

In the next several decades, the rate of growth of review journals can be expected to increase--while the rate of growth of primary journals will probably decrease. The world's scientific research output will continue to grow, of course, but it will be impossible for all of the research to be published in primary journals. Synopsis and other forms of publication will help slow the growth of the traditional primary journals. However, the absolute size of the literature will continue to increase significantly.

These two situations--the underutilization of Ph.D.'s and the increasing importance of reviews--present an opportunity to create a new profession, that of the "full-time" scientific reviewer.

It is essential for a competent reviewer to have subject expertise and exposure to the research experience. In addition, reviewers

must understand modern methods of information retrieval and organization. And they must be able to write clearly and concisely. Many unemployed persons with doctoral degrees have the necessary subject expertise, are trained in research methodology, and have at least a passing acquaintance with scientific communication. For those who need it, clear writing is a skill which can be taught. One wonders how anyone received a doctorate without such skill.

I have in mind a "scientific reviewer" curriculum which could be combined with a program of instruction including information retrieval and scientific writing. At present, not a single university provides this type of program. However, a dozen or so universities have information science programs easily modifiable to this curriculum. Furthermore, a few with graduate programs in scientific communication would be suitable.

Post-doctoral training of no less than one year would be essential to the creation of the new profession. Ideally, the program would be headed by a scientist who is experienced in writing reviews. Most of the candidates for program head would be drawn from the ranks of science specialties; information scientists would also qualify. The severity of unemployment among Ph.D.'s suggests that there will be no shortage of students.

In addition to courses in information sciences, the "scientific reviewer" curriculum would include courses in on-line searching techniques and in the history and sociology of science. Intensive training in science communication, with emphasis on writing, is essential. I would also stress the value of advanced reading knowledge in two or more foreign languages pertinent to the student's field of interest. This could be offered as an option, and might add an additional year of studies, preferably abroad.

Once programs like this were established, I expect that many universities could launch science review journals based on the output of their graduate students--much like law review journals.[6]

Some may argue that "scientific reviewer" is just another name for an "information scientist." But I think the distinction is real and important. In any case, the number of recent Ph.D.'s who go on to receive the Master's Degree in Information Science is trivial. And of these, many are not qualified to do reviewing--although at present they are often the best candidates we have.

For years I have been urging the National Science Foundation to help fund educational programs like that

outlined above.[7] I can't understand their reluctance to attack this fundamental lack in our science education system. Programs like that proposed here could become self-sustaining after a short period, and the benefits to the research community would be significant. Hopefully, administrators would soon learn to allocate funds in their research budgets for direct purchase of reviews as well as other information tools. If not, the government might find itself subsidizing the continued employment of reviewers. Publishers and other organizations could help by supporting fellowships.

I won't attempt to spell out here how and why reviews improve the retrieval of scientific information. But it will be obvious to many that critical reviewing represents the ultimate in in-depth indexing of the primary literature. And once the size of the review literature exceeds 100,000 or more articles per year, as inevitably it must, then we can look forward to the review of reviews.

If my suggested curriculum is implemented and given government support now, it will be a small step from "scientific reviewer" to "reviewer of scientific reviews." Perhaps in the future it will be the scientific elite[8] who will be expected to produce such reviews of reviews, as an obligation both to the scientific community and to the laymen that support their efforts.

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